

## MATH 113: DISCRETE STRUCTURES COURSE INFORMATION & SYLLABUS

FALL 2020

Place:	MW — Wind Tent (North Eliot lawn) F — online via Zoom
Time:	F01 — MWF, 10:05–10:55 A.M. F02 — MWF, 1:35–2:25 P.M.
Instructor:	Kyle Ormsby (ormsbyk@reed.edu)
Office Hours:	Drop-in M 3–4 P.M., W 11:05 A.M.–12:05 P.M., and by appointment
Problem Sessions:	TBD
Textbook:	<i>Discrete Structures</i> by Ormsby & Perkinson
Supplies:	personal whiteboard, markers, and eraser graphics tablet or tablet computer with stylus
Website:	people.reed.edu/~ormsbyk/113/

**Course description.** This course is a rigorous, problem-centered exploration of the mathematics of discrete structures focusing on the following subjects:

- » *Combinatorics* tells us why there are 40,320 ways to place eight non-attacking rooks on an  $8 \times 8$  chessboard. We will learn how to count permutations, combinations, derangements, and other collections, develop the language of sets and functions, and utilize basic proof techniques like the pigeonhole principle and mathematical induction. We will touch on graph theory, trees, and Catalan structures as well.
- » *Probability* tells us why it's likely that two people in a class of 23 students share a birthday. We will study conditional probability, Bayes' Theorem, and expected values.
- » *Number theory* tells us why we shouldn't try to solve the equation  $a^3 + b^3 = c^3$  with nonzero integers. Topics include divisibility, prime numbers, the Fundamental Theorem of Arithmetic, modular arithmetic, and Fermat's Little Theorem.

**Learning outcomes.** After taking this course, students will be able to:

- » demonstrate an understanding of introductory combinatorics, probability, and number theory;
- » apply this understanding in mathematics, science, technology, and other contexts;
- » work as part of a small group to solve mathematical problems; and
- » communicate mathematical ideas verbally and in writing.

**Distribution requirements.** This course can be used towards your Group III, "Natural, Mathematical, and Psychological Science," requirement. It accomplishes the following goals for the group:

- » Use and evaluate quantitative data or modeling, or use logical/mathematical reasoning to evaluate, test, or prove statements.
- » Given a problem or question, formulate a hypothesis or conjecture, and design an experiment, collect data or use mathematical reasoning to test or validate it.

This course **does not** satisfy the "primary data collection and analysis" requirement.

**Course design.** Nearly all of our meetings will break down into four components:

- » *Reading.* Every class will have an assigned reading which you must complete and engage with before we meet.
- » *Lecture.* A short online lecture and quiz accompanies each reading assignment and must be completed by 9A.M. on the day of the accompanying class. After taking the quiz, you are encouraged to discuss the video and ask questions on our Slack channel.
- » *Active class sessions.* Our 50-minute meetings will focus on group work with your peers. Collaborative problem-solving will allow you to interact with and grow your understanding of the material. There will be many opportunities for presenting solutions and proofs to your peers.
- » *Homework.* I will assign two or three harder homework problems for you to complete after class. These are due two class periods later via Gradescope.

The purpose of this structure is to scaffold your learning so that you will first engage with easy quiz problems based on your reading and the recorded mini-lecture, then bolster skills through collaborative problem-solving, and finally gain mastery over content by engaging with homework problems.

Here's an example of how the course design will play out in practice: Suppose that it's Friday of the second week of classes. By 9A.M., you'll complete the reading, lecture, and online quiz related to that day's content. You will use gradescope to turn in the homework problems related to the content delivered on Monday of the second week of classes. We will then spend the class period engaged in group work related to the reading assignment and recorded lecture. You will leave that class prepared to work on the homework problems which are due Wednesday of the third week. If you have difficulty with the homework problems or any of the course material, you could attend office hours.<sup>1</sup>

**Texts.** The course will use a draft version of *Discrete Structures* as its primary text. This is a free PDF file available on the course website which will be updated as the semester proceeds. Previous iterations of Math 113 have used *Discrete Mathematics: Elementary and Beyond* as a textbook; you may find it to be a useful supplementary text.

**Reading assignments and mini-lectures.** The required reading and recorded lectures are essential to the course and provide a leaping off point for each of our class meetings. The associated quizzes are intended to ensure that you are following the text and lecture at an appropriate level; they should not be particularly hard, though some of the problems will be nontrivial. The quizzes are embedded into the mini-lecture videos (posted to the course website) and are due by 9A.M. on the day of class. (This will allow me to review the class's comprehension of the material before we meet.) Quizzes will be assessed primarily on the basis of completion.

**Homework.** Homework is due via Gradescope<sup>2</sup> every class meeting, based on the content covered two meetings prior. Excellent solutions take many forms, but they all have the following characteristics:

- » they are written as explanations for other students in the course; in particular, they fully explain all of their reasoning and do not assume that the reader will fill in details;
- » when graphical reasoning is called for, they include large, carefully drawn and labeled diagrams;

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<sup>1</sup>You could also work on the problems with peers (see the Collaboration section), attend the problem session or drop-in tutoring (see the Help section), or ask a question via email or Slack (see the Slack section).

<sup>2</sup>Gradescope is an online homework submission and evaluation platform. You will receive a link to register for our class's Gradescope page during the first week of classes.

- » they are neatly written or typeset;<sup>3</sup> and
- » they use complete sentences, even when formulas or symbols are involved.

I reserve the right to not accept late homework. If health or family matters might impede the timely completion of your homework, please contact me as early as possible.

**Collaboration.** You are permitted and encouraged to work with your peers on homework problems. You must cite those with whom you worked, and you must write up solutions independently. **Duplicated solutions will not be accepted and constitute a violation of the Honor Principle.**

**Feedback.** You will receive timely feedback on your homework via Gradescope, either from me or the course grader (another mathematics undergraduate). Each homework problem can earn up to five points for mathematical content, and two points for the quality of writing. If your answer is incorrect, this will be reflected in the score, and there will also be a comment indicating where things went wrong with your solution. You are strongly encouraged to engage with this comment, understand your error, and try to come up with a correct solution. You are very welcome to post questions about old homework problems to the Slack channel (see below) and talk about them with me in office hours (see the Help section).

**Tests.** We will have two midterm exams and a final exam. You may reference one two-sided US Letter or A4-size page of notes during each exam. Calculators, computers, phones, collaboration, books, and the Internet are prohibited during exams.

- » Exam 1: distributed via email Monday, 21 September; due via Gradescope Wednesday, 23 September.
- » Exam 2: distributed via email Wednesday, 21 October; due via Gradescope Friday, 23 October.
- » Exam 3: as scheduled by the registrar, 10–15 December.

**Joint expectations.** As members of a communal learning environment, we should all expect consideration, fairness, patience, and curiosity from each other. Our aim is to all learn more through cooperation and genuine listening and sharing, not to compete or show off. I expect diligence and academic and intellectual honesty from each of you. You should expect that I will do my best to focus the course on interesting, pertinent topics, and that I will provide feedback and guidance which will help you excel as a student.

**Help.** There are a number of resources you can access for help with this course’s content. Everyone is welcome and encouraged to attend my office hours. These will be held online Monday 3–4P.M. and Wednesday 11:05A.M.–12:05P.M. on a drop-in basis; see our Slack channel for a Zoom link to attend. I am also happy to arrange online or in-person office hours by appointment. Office hours are an opportunity to clarify difficult material and also delve deeper into topics that interest you. Please reach out to me if there are barriers preventing you from effectively utilizing this opportunity.

Additionally, all sections of Math 113 have a joint problem session twice a week at times to be determined shortly. The problem sessions will provide a structured, facilitated environment in which you can collaborate on homework. Remote access details will be determined shortly and posted on the course website.

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<sup>3</sup>Interested students are encouraged to prepare solutions in the  $\LaTeX$  document preparation system. A guide to  $\LaTeX$  resources is available on the course website. Nearly all of the .pdf files on the course website are produced by  $\LaTeX$ ; you can find their associated source files by changing the .pdf suffix to .tex in the file’s URL.

The math department also hosts drop-in tutoring on Zoom Sunday, Monday, Tuesday, Wednesday, and Thursday 7–9P.M. Upperclass tutors will be available to clarify concepts and help you with homework problems.

Finally, every Reed student is entitled to one hour of free individual tutoring per week. Use the tutoring app in IRIS to arrange to work with a student tutor.

**Slack.** All sections of Math 113 this term have a shared Slack channel. Use the Slack channel to ask questions (of me or the class), collaborate on problems, and share resources. The Slack channel is an extension of our classroom and the above joint expectations extend to this setting. You will receive an email invitation to join our Slack channel during the first week of classes.

**Technology.** The use of electronic devices (cell phones, computers, tablets, calculators, *etc.*) is strictly prohibited in the classroom without prior authorization from the instructor. That said, legitimate uses of technology (*e.g.*, note-taking) will be accommodated — just talk to me first.

**The Internet.** You are welcome to use Internet resources to supplement content we cover in this course, with the exception of solutions to homework problems. **Copying solutions from the Internet is an Honor Principle violation and will result in an academic misconduct report.**

**Academic accommodations.** If you have a documented disability requiring academic accommodation, please have Disability & Accessibility Resources (DAR) provide a letter during the first week of classes. I will then contact you to schedule a meeting during which we can discuss your accommodations. If you believe you have an undocumented disability and that accommodations would ensure equal access to your Reed education, I would be happy to help you contact DAR.

**Math in the Time of COVID-19.** It is essential that all students, faculty, and staff at Reed follow the college's public health rules and guidance during the COVID-19 pandemic. This will help ensure your and the community's safety. During our class periods, you must wear a mask covering your mouth and nose, and you must remain six feet (two meters) distant from other class members.<sup>4</sup> Carefully track any cold/flu/COVID-19 symptoms you are experiencing and **do not come to class if you are ill.**

Students who miss class due to illness for a short period of time (one or two class meetings) should contact the instructor for instructions on how to keep up with course material. Students who are ill for longer, are isolated due to COVID-19 exposure, or are in quarantine will participate in Dave Perkinson's online section of Math 113, F03. Dave and I are coordinating our sections, which should make for a relatively smooth transition. If a sufficient number of students need this accommodation, I may host a separate online section of Math 113 as well.

In order to reduce the risk of COVID-19 transmission during class meetings, our sections of Math 113 are held outdoors in a tent classroom. Please dress in layers that will allow you to stay comfortable in variable weather conditions. If the weather is particularly bad, our sections will meet online instead of in-person; if this happens, an announcement will be made via email and on Slack. Our class will also meet online during the final week of classes (after the extended Thanksgiving break).

Our sections of Math 113 require two special items that will facilitate our mathematical work under these conditions:

- » **Personal whiteboard, markers, and eraser.** You are responsible for bringing a medium-sized personal whiteboard, markers, and eraser to each class meeting, which you will use to display work during socially distanced small group work.

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<sup>4</sup>This can be especially challenging when entering, exiting, or moving about the classroom. It's OK to be slightly closer than six feet when moving through space, but please move quickly and do not linger in any one person's vicinity.

- » **Graphics tablet or tablet computer.** If you do not have one already, please purchase a graphics tablet<sup>5</sup> or tablet computer with stylus (*e.g.*, iPad). This technology will allow you to share handwritten notes during online class and office hour meetings, and will likely prove useful in other coursework and online collaboration with peers. I recommend sharing handwritten notes on a digital whiteboard app like Google Jamboard or AWW (A Web Whiteboard).

**Grades.** Your grade will reflect a composite assessment of the work you produce for the class, weighted in the following fashion: 35% homework, 25% final exam, 20% exam 2, 10% exam 1, 5% quizzes, 5% class participation.

Remember: *Math is hard, but we're going to get through this together!*

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<sup>5</sup>Graphics tablets are computer input devices that connect to a laptop or desktop computer via USB or Bluetooth and then allow you to hand-draw images and writing. Quality graphics tablets can be purchased for less than the price of a textbook.